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WEATHER AROUND THE WORLD

Volume 8, Number 2 April 1955

"SOME PEOPLE ARE WEATHERWISE BUT MOST ARE OTHERWISE"—BENJAMIN FRANKLIN

WEATHERWISE

THE MAGAZINE ABOUT WEATHER

DAVID M. LUDLUM, *Editor* HENRY W. BULKLEY, *Associate Editor*

AMS Spring Meeting

The annual spring meeting in the Washington, D. C. area will be held on 2–6 May 1955. This will be the 136th National Meeting of the American Meteorological Society and some of the sessions will be held in conjunction with the American Geophysical Union.

The program will cover a wide range of meteorological subjects. The designations of the technical sessions are as follows:

Severe Storms
Symposium on Observational Requirements in Meteorology (2 sessions)
Normal and Tangential Stresses near the Air-Surface Interface
Meteorologically Induced Changes in Water Level (2 sessions)
Dynamic Meteorology
Climatology
Diffusion and Eddy Motion (2 sessions)
Upper-air Meteorology
Synoptic Meteorology (2 sessions)

A dinner will be held on Thursday, 5 May, at the National Press Club and a cocktail party will precede the dinner. Guest speaker at the dinner will be a councilor of the Society, Mr. Patrick D. McTaggart-Cowan, vice-controller of the Canadian Meteorological Service, who will speak on "Who is the Weather Man?".

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Front Cover: A street window display of books about the weather was featured during February by the Enoch Pratt Free Library of Baltimore, Maryland. Meteorological instruments and the photograph are courtesy of Bendix-Friez.

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The Weather of Formosa

MAJOR W. B. WILLIS,
Headquarters, Air Weather Service, Directorate of Climatology

FORMOSA, meaning "Beautiful Green Island" in Portuguese, was the name given this controversial island during the seventeenth century by explorers from Portugal. It is the name most commonly used at the present time by the occidental race. Taiwan is the Chinese name for the island meaning "Terraced Bay" and it is the designation most generally used by the island's local populace.

Formosa has an area that is approximately equal to the combined areas of New Hampshire and Connecticut. The island is divided into a western coastal plain and an eastern rugged mountain range. This mountain range, Chung-yang Shan-mo, is oriented approximately north and south and extends the length of the island. The central ridge of this mountain range extends upward to an average height of 9,000 feet, with the highest peak at 12,960 feet.

The topography of Formosa has a marked effect upon the weather of the island and the surrounding area. The worst weather occurs on the windward side of the mountain range which is predominantly the northeast in winter and the southwest in summer. Between the mountains of Formosa and southeastern China there is a strong venturi or constrictive effect evident. This condition is believed to be largely responsible for making the low-level winds in the Formosa Strait among the most persistently strong in the world.

The climate of Formosa ranges from temperate in its extreme northern area and at the higher elevations in the mountains to tropical over the remainder of the area. The island's geographical location places it under the influence of the Asiatic monsoon structure.

The winter monsoon exists when the strong continental high dominates most of China and Siberia. At this time the airflow in the lower levels over Formosa and in the Strait is generally from a northeasterly direction. Due to the overwater trajectory, the air in the lower layers is usually moist and cool or cold when it reaches Formosa. During this season the northeastern sector of Formosa has extensive cloudiness and rain caused by orographic lifting. The entire east coast is similarly affected, but with decreasing amounts

A flight of U. S. Air Force F-86 "Sabre" jets patrolling over rugged mountain terrain such as covers most of central and eastern Formosa. U. S. Air Force photo.

of rain to the south. Southwestern Formosa experiences relatively warm, dry weather during the winter monsoon, principally due to the downslope effect.

April, May, and June comprise the spring transitional period between the winter and summer monsoons. During this period the tropical air of the Pacific is displacing the polar air from the continent. The boundary line or transitional zone between these two air masses is commonly termed the polar front. This season is generally very cloudy and wet, with the month of June especially so during the years that the polar front becomes practically stationary over Formosa.

The summer monsoonal southwesterly flow of tropical maritime air is warm, moist, and unstable to great altitudes. Well-developed convective clouds and frequent heavy rains are common during the day over the southern and western sectors of the island. During this season the areas east and northeast of the mountain-divide have prevailing good weather.

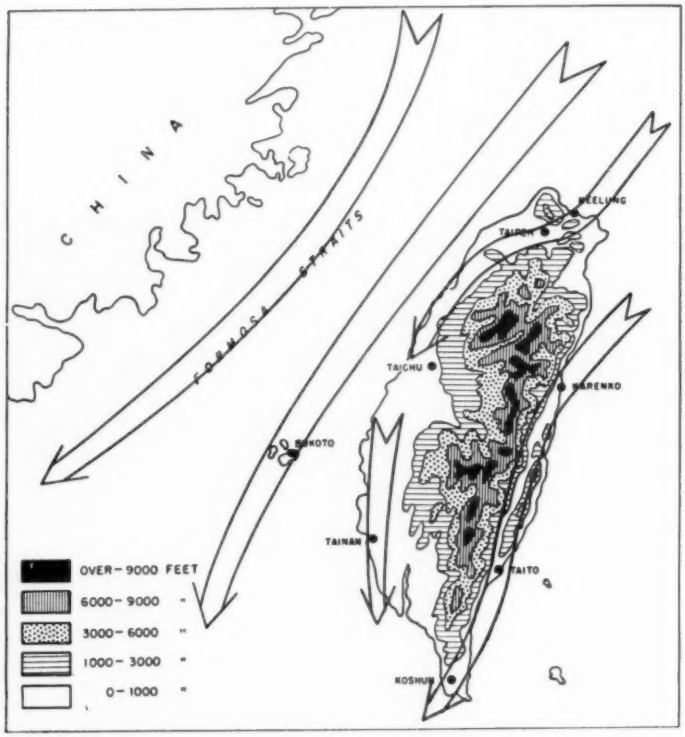
The autumn transitional season is a period of relatively fair weather for Formosa. The polar front may fluctuate over the area for a day or two at a time and during its passage cause extensive rain over the entire island.

This, briefly, is a resume of the seasonal character of the climate of Formosa. Individual weather elements follow a similar pattern.

PRECIPITATION

The driest month for most of Formosa is December or January with from one to three inches of rain expected. The exception, of course, is the northeast coast, where exposure to the winter northeasterly flow causes the area to have its rainy season at this time with from 13 to 38 inches of rainfall.

The wettest month for the island has from 13 to 42 inches of rain and may occur from June through September. The exception is the northeast coast which now has its dry season and where 6 to 7 inches of rainfall may be expected.



Prevailing surface air flow over Formosa and vicinity for the winter monsoon season from December through March.

Well-marked local variations in rainfall may result from altitude and exposure to prevailing winds. Annual rainfall at villages located within seven miles of each other may vary from 70 to 130 inches.

During the summer monsoonal and typhoon season, over 10 inches of rainfall per day (24 hours) may occur at almost any place in Formosa and up to 41 inches have been known to fall. Funkiko, Formosa, noted for some of the heaviest rainfalls in the world, has experienced 82 inches of rain in a three day period. This represents twice the annual rainfall over a large part of the United States.

The mean annual precipitation for the island ranges from 70 to 283 inches, depending upon the locality, and may be more for rather isolated mountain localities for which past records are not available. The heavy rains cause uncontrollable floods along the winding rivers. With few exceptions, however, the torrential rivers of summer become tiny rivulets in winter.

Almost all precipitation falls as rain. Snow may be seen in the mountains from December through February but seldom, if ever, occurs below 3,500 feet.

CLOUDINESS

Areas and seasons of maximum cloudiness over Formosa coincide with those of maximum rainfall.

Winter is the season of maximum cloudiness in the northeast, with approximately 20 days per month having cloudiness exceeding 80 per cent and not more than two clear days per month. Clouds are predominantly stratiform with bases 1,000 to 3,000 feet. They occasionally drop as low as 200 feet for several successive days. The stratiform clouds tend to break up as the day progresses; therefore, more cloudiness can generally be expected during the mornings than during the afternoons.

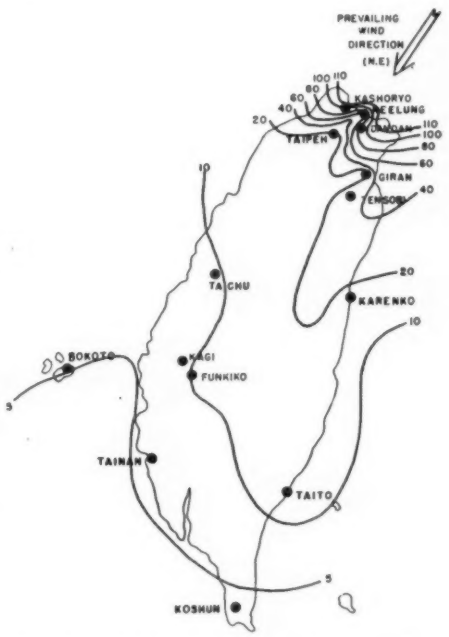
During the summer the southwestern slopes and interior mountains have their cloudiest season with generally less than two clear days per month. Summer cloudiness is cumuliform. This type of cloudiness increases as the day progresses. The western coast has between 40 and 45 days during which thunderstorm activity is prevalent and the number is probably considerably higher in the mountains. Bases of the cumuliform clouds are generally 1,500 to 3,500 feet. Extremely heavy rainfall usually reduces the visibility to considerably less than a mile in shower areas. In the typhoons of summer and early autumn cloud tops extend to 30,000 feet and higher.

VISIBILITY

Fog is encountered so infrequently over the lowland and coastal stations that it is not a concern. Precipitation and haze are primarily responsible for restricted visibilities. At both Taipei and Tainan afternoon visibilities are more than three miles on more than 90 per cent of the days from May through October. Visibility aloft may be frequently reduced by haze extending above 10,000 feet during late autumn and early winter. Visibilities are generally best for the entire island from early summer through late autumn.

TEMPERATURE

The seasonal variation of temperature is regular with minimum temperatures usually



A typical rainfall pattern for the winter monsoon season from December through March. Figures are the mean rainfall in inches for the four-month period.

Mean Temperatures (°F.)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Yrs Rec
Taipei	60	59	63	69	75	80	83	82	79	75	68	62	71	30
Koshun	69	69	72	76	79	81	82	81	80	77	74	70	76	30

occurring in late January. They may occur as late as February at stations exposed to maritime effects. Maximum temperatures usually occur in July and August.

Winters are generally cool in the lowlands with mean temperatures in the high fifties to high sixties. Freezing temperatures are normally encountered above 3,500 feet in the mountains of the northeast and eastern areas of the island. They have been reported near sea level in the northeast areas on the extremely rare occasions when cold Siberian air has penetrated that far south.

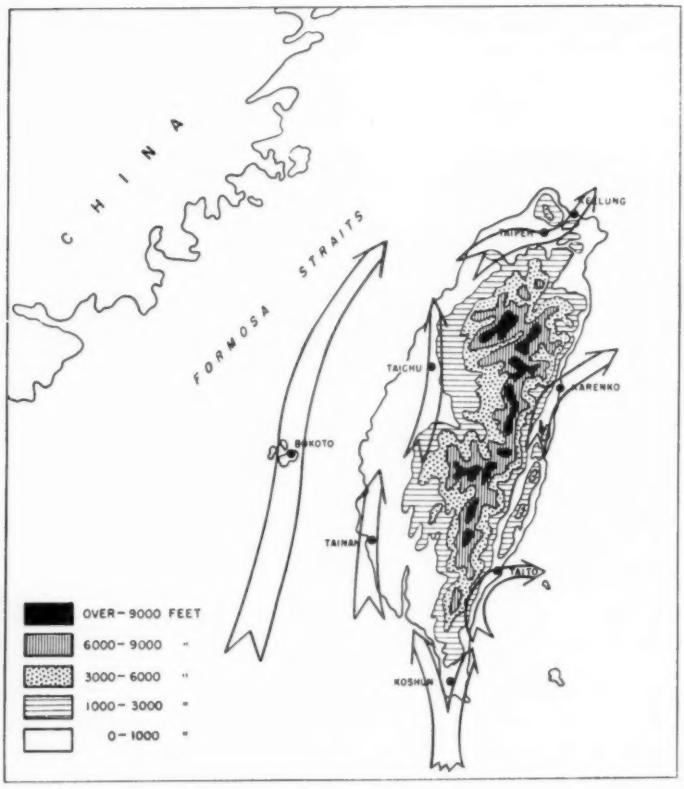
Summer seasons are normally rather hot and humid. Mean temperatures in the lowland areas range from the low to mid-eighties.

Annual temperature ranges are small. Mean temperatures for Taipei in the north and Koshun in the south are presented in the accompanying tabulation.

Extremes of temperature range from 18° F. at villages in the mountains to 103° F. for localities in the lowlands. The mountain areas experience from 20 to 25 degrees daily temperature ranges. Few stations at the lower elevations have mean daily temperature ranges greater than 16 degrees during any season.

HUMIDITY

The mean relative humidity ranges from the mid-seventies through the low nineties for most of the island throughout all seasons of the year.



Prevailing surface air flow over Formosa and vicinity for the summer monsoon season from June through September.

SURFACE WIND

Formosa is a region of distinct seasonal changes in surface wind direction. High northeasterly winds, frequently of gale strength and very persistent in direction, are common at coastal stations of Formosa and in the Strait during the winter months. Mean winds of 22 to 25 mph may be expected in the Strait during this season. Similar wind velocities are found over most of Formosa with the exception of the southwestern coastal area where considerably lower rates prevail. In the summer season the mean winds for the same areas in and around Formosa drop to 5 to 10 mph from a southerly direction, with the exception, of course, of those times that typhoons are in the immediate area.

TYPHOONS

In the western Pacific Ocean an average of 20 to 30 typhoons may be expected per year; but even in the season of usual maximum occurrence, no typhoons may occur for as long as a month. About six typhoons strike Formosa each year.

The Pacific area 300 to 600 miles southeast of Formosa is a favorite place for recurvature of western Pacific typhoons. While one is in the process of recurving, it is very difficult at the present time to forecast with any high degree of accuracy where it will be in 48 hours.

Typhoons generally approach Formosa from the east, southeast, or south. Those that approach and strike the island from the east or southeast generally do not cause much damage to the more densely populated lowlands on the western side. The mountain range will usually weaken a typhoon to such an extent that winds within it seldom exceed 40 knots when it passes over to the western half of the island. Those approaching from the south, which pass through the Strait, cause the greatest damage to the lowlands. Typhonic winds, intense rain, destructive seas, high tides, and flooded areas may bring about catastrophes of a magnitude unknown in other parts of the world.

Typhoons may occur in the Formosa area from May through November, but approximately 81 per cent of the typhoons affecting Formosa and the Strait occur during July, August, and September.

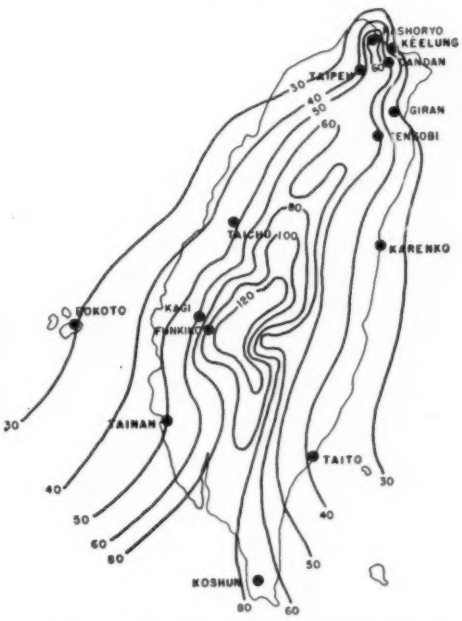
Briefly then, the following aspects of the climatic picture should be given consideration when long-range operations are to be carried out in this area:

1) Typhoons are a definite threat to the area during the summer season, with approximately two per month during July, August, and September actually striking the island. All operations are usually seriously impaired or must actually stop during the typhoon passage through the area.

2) The seas around Formosa and in the Strait are often high enough, due to the strong winds during the winter months, to hamper movement of ocean-going vessels. Along the east coast, heavy seas are frequent in summer as a result of the high occurrence of typhoons over the ocean to the southeast. The lowest swells and seas prevail from May through July in and north of the Formosa Strait. This is probably the best season of the year for all types of surface vessels to operate in this area.

3) Icing is not a serious problem. Ground operations in the mountains during the winter months will encounter light snow and freezing

(*Continued on page 58*)



A typical rainfall pattern for the summer monsoon season from June through September. Prevailing wind changes from southeast to south to southwest as summer progresses.

The cloud bank and funnel clouds over Lake Champlain on 12 February 1954. Photograph was taken by J. E. Stork from the Burlington Airport about eight miles from the cloud bank.

Winter Funnel Clouds over Lake Champlain

ROBERT G. BEEBE, *USWB, Kansas City*
J. E. STORK, *USWB, Burlington, Vermont*

WINTER weather in Vermont is normally characterized by snow and cold temperatures rather than by the occurrence of tornadoes or funnel clouds. Indeed, tornadoes have been observed in this state on only five occasions, all during the summer, from 1916 through 1950. Imagine, then, the surprise of the Severe Local Storm Warning Center forecaster on the morning of 12 February 1954 as he read the 0928 EST report from Burlington, Vermont:

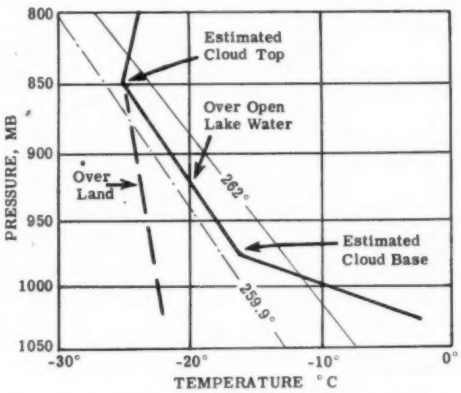
BTV 8⊕15⊕30 253/-8/-21 ↓18+27/024 series of funnel shaped clouds over Lake Champlain mostly extending from clouds to surface and moving from north to south. Funnels appear to be small tornadoes forming then moving southward a few hundred yards, dissipating, then new ones forming at north end of cloud cover just west of station.

A cold front moved across New England during the evening of 10 February and was followed by a strong flow of cold northerly winds. This flow of cold air was strengthened by a deepening Atlantic coastal storm on 11 February, so that by the next morning strong northerly winds were bringing very cold air into all of New England as shown by the surface map at 0130 EST. During the past three years Lake Champlain has not been completely frozen over and on this day there was an area of open water about one-quarter of a mile wide and seven miles long extending along a north-south line in the middle of the lake just west of Burlington. The temperature of the water at the intake of the city filtration plant was 33° F.

Upper-air soundings are not taken at Burlington but an estimate of the temperature lapse rate in the lower atmosphere is shown. It is assumed here that the air between the surface and the base of the cloud layer estimated to be 1,000 feet was heated enough to establish an autoconvective lapse rate of 3.42° C/100 m. and within the cloud itself the lapse rate followed the moist adiabatic rate. This is a reasonable assumption, as the surface air over the open lake water would have a temperature of 28° F, five degrees below the actual temperature of the water, which was 33° F. Nearby upper-air soundings at 1000E showed that the 850 mb temperatures in the vicinity of Burlington would be near −25° C and with a sharp temperature inversion above this level. On the other hand, if it is assumed that the lapse rate from the surface to 850 mb is constant, then the lapse rate would be nearly 2° C per 100 mb, which is about twice the value of the dry adiabatic lapse rate. In either case there is no question that the air below 5,000 feet was very unstable.

Beginning about 0800 EST there was visual evidence of considerable turbulence in the long north-south belt of low clouds over the lake. These clouds existed only over the open lake water and the bases were estimated at 1,000 feet above the lake level. From the photograph, the tops appear to be between 3,000 and 4,000 feet above the lake level. While the waterspouts are not clearly defined in this photograph, at least one shows up rather well near the center of the picture and it appears to be detached from the cloud base. The open water in the middle of the lake was four miles from the shore line and the airport is four miles inland, thus locating the narrow band of clouds some eight miles west of the Weather Bureau station and oriented along a north-south line about seven miles long. By 0915 irregular formations, resembling waterspouts extending below the cloud base, were seen to develop into funnels and then writhing, rope-like appendages extended downward apparently to the lake surface. Within a few minutes it became evident that these were fully developed, though small, waterspouts. Although the gusty surface winds were from the north 18 mph during this time and the gradient wind was from 330 degrees at 30 knots, the cloud itself appeared to remain stationary over the open water. Actually, however, the cloud was undergoing a process of formation at the north end and dissipation at the south end of the open water and throughout its existence a great deal of turbulence and churning around the edges of the cloud was visible. A reliable eye-witness, who was on duty at the ferry dock at the time, confirmed that the funnels reached down to the lake surface.

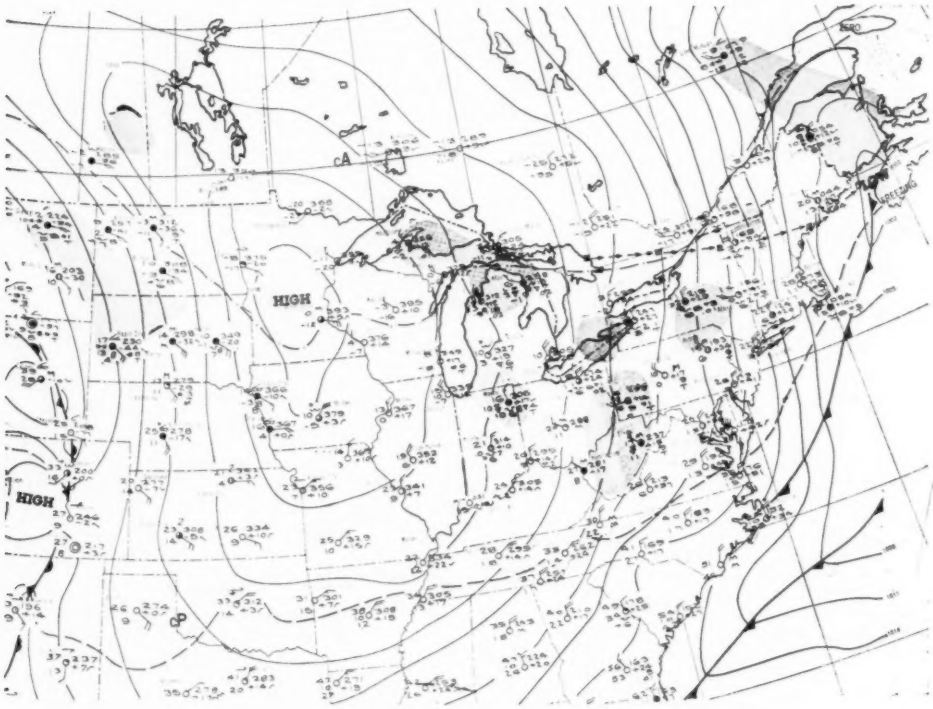
While the north-south extent of the main cloud was about seven miles, the funnel clouds were observed only over a distance of a little over two miles, beginning near the northern limit of the cloud. Due to terrain obstructions to the southwest, as well as poor visibility in that quadrant due to steam fog, it is not known whether funnel clouds extended along the full length of the main cloud. Some of the funnels appeared to become temporarily detached from the cloud and continued moving southward, occasionally rejoining the cloud base. All of the funnels were observed to move southward with the wind, but so many funnels were forming all along the cloud base that it was not possible to ascertain whether a particular funnel traveled the entire length of the visible cloud.



A hypothetical sounding at Burlington, Vermont, on 12 February 1954 at 1000 EST. The heavy solid line is the estimated temperature curve over the open lake water and the dashed line is the estimated temperature curve over land. A dry adiabat and a moist adiabat are given for reference.

It was estimated at the Weather Bureau station that at least 40 complete funnels plus a hundred or more partial funnels were observed and all of them seemed to form and remain only over the open lake water. The severe turbulence and funnel clouds ended soon after 1140, but the main cloud remained over the open water until shortly after 1428, or nearly three hours after funnel activity ceased. The gusty surface winds at the airport continued from the north with no appreciable change in either direction or speed throughout this period.

Severe Local Storm Warning Center forecasters are primarily responsible for the issuance of severe weather forecasts for national teletypewriter distribution and for coordinating these forecasts between forecast centers for issuance to the general public. The SELS Center maintains a national weather watch on all teletypewriter weather reports, including radar, upper-air, surface, and pilot reports. The unusual and unexpected meteorological phenomenon described in the remarks from the Burlington, Vermont, record report at 0938 was noted by the SELS forecaster on duty that morning. He immediately reached the District Forecast Office in Boston, who, in turn, called the Weather Bureau Airport Station in Burlington. Following these discussions it was decided that this was a strictly local phenomenon and would remain very close to the source of moisture and heat in midlake so that there was no danger to persons or property. Therefore, no severe weather forecasts were issued by SELS Center nor severe weather warnings by the Burlington office. Subsequent developments showed this reasoning to be a correct appraisal of this situation.



A sectional surface map for 0130 EST on 12 February 1954. USWB chart.

Samuel K. Pierson, in center carrying papers, greets his fellow-commuters with some weather wisdom. Photo by Richard C. Gaine.

Sam the Weatherman

VAL E. VALLERY, *Plainfield Courier-News*

FIFTY years of observing weather conditions in the Plainfield and Jersey City areas for the U. S. Weather Bureau, gratis, is being marked by cooperative weather observer, Samuel K. Pearson of 1217 South End Parkway during 1955. Records of "Sam the Weatherman" show his forecasts published in this newspaper and others in New Jersey have proved 85 per cent correct.

Plainfield's cooperative weather observer started noting weather for the U. S. Weather Bureau in this area in 1920. "Not one day's record is missing from my files since I started here, and many thanks go to 'pinch-hitters' and my daughters, who filled in during my vacations," he said.

Known to thousands in this area, and particularly to commuters on the Central Railroad of New Jersey, Mr. Pearson is an imposing figure, tall, slight and a bit of a Beau Brummel, complete with his ever-present tie stick pin. He is a lover of good music and an ardent opera fan.

Mr. Pearson was appointed a cooperative observer by the Weather Bureau in 1905 while a resident of Jersey City. He was 19 years old at the time.

Since Mr. Pearson came to Plainfield, he has been dispensing weather information regularly, not only to newspapers, but to hundreds of commuters at the Plainfield station who await his presence each morning before he embarks for his office in New York.

Asked if he intends to retire as an observer now that he has given 50 years to the work, Mr. Pearson replied, "I'm afraid I like weather observing too much to retire."

In fact, Mr. Pearson now maintains an office at 39 Courtland Street in New York City where he has hung out his shingle as a consulting meteorologist. Since his retirement from his position with a New York bank, Mr. Pearson has specialized in the legal aspects of weather conditions and is a familiar figure in New York and New Jersey courts as an expert witness on weather matters.

Simple Experiments in Atmospheric Physics—1

VINCENT J. SCHAEFER,
Director of Research, The Munitalp Foundation, Inc.

ONE of the fascinating things about weather is that it is an active, moving, dynamic thing. In order to study its ways, we do not need to go to far places—the weather comes to us, no matter where we are. If we are to enjoy weather, the "bad" as well as the "good," we should have intelligent eyes and a curiosity to know more about the reasons why things happen as they do.

For a proper understanding of the changes which occur in the weather and whose many visible effects are about us daily, we plan to describe a series of simple experiments that any teen-age boy or girl can do. We will show how it is possible to prepare a tiny sample of the atmosphere so that one can see some of its properties and actually produce physical and chemical changes. These experiments are not only spectacular and interesting, but at the same time answer many questions about the atmospheric reactions that cause rain and snow, halos, clouds, storms, and many other things that combine to produce the phenomenon we call weather.

THE COLD BOX

A cold chamber is both very simple and at the same time very useful for making observations or for conducting experiments in atmospheric physics.

In its basic form it is an open-topped box whose walls and bottom are colder than the surrounding air. The walls of this chamber must be black. The easiest and probably best method for producing this condition is to line the chamber with black chiffon velvet, a cotton cloth woven so that it is porous but fairly thick. A bright light will shine through it, but the openings are so small that they serve as a barrier for everything except microscopic particles and radiation. The importance of this feature will be mentioned later. The chiffon velvet liner should be supported on a wooden frame so that it may be held one-quarter to one-half of an inch from the cold walls and bottom of the chamber.

The temperature to which the air in the chamber may be cooled is not critical, although the colder this can be the greater are the number of experiments that may be conducted. It is not necessary to have the temperature colder than −40° C and for most purposes a temperature of −20° C (−4° F) is sufficient. This temperature may be obtained in a variety of ways; chambers which will not produce this degree of cold will not prove satisfactory for these experiments.

The most suitable experimental chamber is the commercial 4-cubic foot home freezer used for storing frozen foods. Our first illustration shows a method of adapting such a chamber to experimental studies. This does not require any changes in the freezer except the removal of shelves and containers.

The next best arrangement is to acquire the use of a portion of a larger home freezer. By suitable construction of a black velvet lined frame, one end or a corner of an 8, 11, 16, or 20-cubic foot chest type home freezer may be prepared for temporary experiments.

The properties of the air in a chest type chamber permit this arrangement. Since the cold air is heavier than warm air, it remains

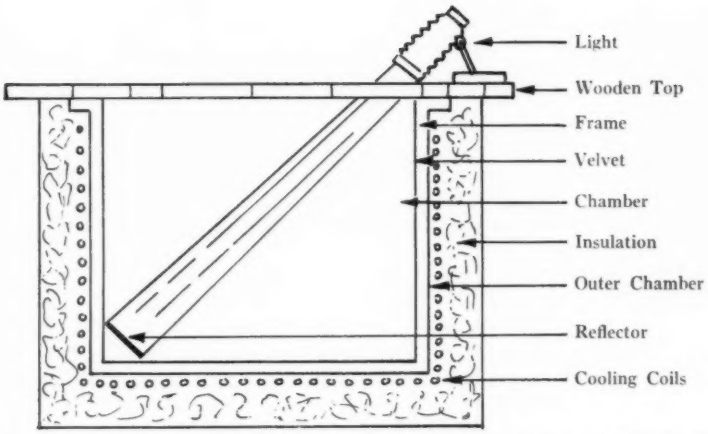


Fig. 1.—SCHEMATIC DIAGRAM OF COLD CHAMBER. Capacity: 2–4 cubic feet.

in the chamber even when the top is open to the surrounding warm air. The larger the difference in temperature between the air in the chamber and the surroundings, the more stable is the cold air within. For this reason it is not possible to use freezers with side door openings, since the cold air would immediately flow out when the door opens. If such a unit is available and will operate effectively when placed in a horizontal position, it can be used.

Instead of making use of an expensive freezer unit, you may "do-it-yourself" and construct a homemade unit. In order to produce a temperature of about −20° C, you may make use of dry ice (solid CO_2), methanol cooled with dry ice, or a brine solution made by mixing three parts of snow or crushed ice water to one part of rock salt.

Two square washtubs or large tin containers, one of them four to six inches smaller than the other, with the space between filled with the cooling solution, will serve as a cold chamber. The inner chamber should be lined with black chiffon as described for the more elaborate home freezer. In its simplest form such a chamber may be made of two tin cans. But remember that the smaller the working volume is, the more limited will be the ease of carrying out the many experiments we plan to tell you about. As mentioned earlier, a volume of one to four cubic feet is to be preferred.

While the brine solution is probably the easiest to prepare, it is also possible to use a bath made of denatured alcohol and dry ice, using the carbon dioxide gas produced by the

(Continued on page 58)

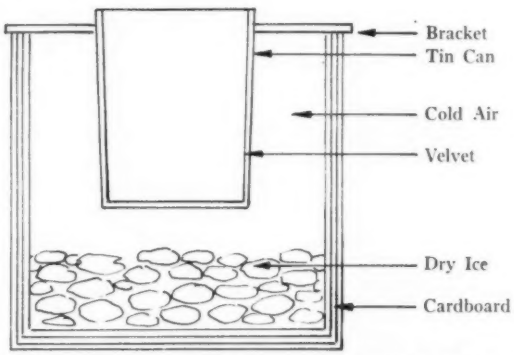


Fig. 2.—SCHEMATIC DIAGRAM OF HOME-MADE COLD CHAMBER.

Recent Books on Meteorology

MALCOLM RIGBY, *Editor, Meteorological Abstracts*

THE reader will find excellent lists of popular books on meteorology in the October 1953 issue of *Weatherwise* on pages 144–147 and in the October 1954 issue on pages 128–132. These include listings of textbooks, handbooks, workbooks, and a few specialized works which would interest the non-professional meteorologist. In addition there is a list of 15 leading meteorological periodicals and over a score of educational films for elementary and secondary schools. These two bibliographies adequately cover the postwar English language texts. In the present article an attempt will be made to bring the reader up to date and to describe in a little more detail those texts published during 1953 and 1954 which would appear to be the most interesting to the *Weatherwise* audience.

Not all of the popular type books can be given adequate coverage in the limited space available. Yet some of the specialized texts should be mentioned, so that a reader who becomes interested in a special branch of the subject, such as micrometeorology, tropical meteorology, climatology, rocket observations of the stratosphere, physical climatology, tornadoes, or thunderstorms, can find something to dig his teeth into.

The student will find numerous elementary textbooks on meteorology or geography in any school library; but he will have to look long before he will find a text which covers the entire field of geophysics or earth science. Such a book has just been issued in a most attractive form for high school students—**Earth Science—The World We Live In by Samuel N. Namowitz and Donald B. Stone.** Van Nostrand, New York, 1953. 438 p. $3.96. The work includes dozens of excellent photographs, schematic diagrams, and questions at the end of each chapter. The five parts or "units" take up: (1) the physics of the solid and liquid part of the earth; (2) the Sun, stars, and planets; (3) the atmosphere; (4) the oceans; and (5) climatology. There is an excellent and detailed subject index. Emphasis is now being placed on research specialists or technologists who are competent in more than one field of science. Thus, the student who specializes in dual subjects such as meteorology and hydrology, climatology and oceanography, astrophysics and atmospheric physics, will find himself in greater demand than the mere specialist in one field. *Earth Science—The World We Live In* will make an excellent start for the student who wishes to commence a systematic study of our physical world.

Seemingly at the other extreme with respect to degree of specialization, yet actually bringing together meteorology, architectural engineering, public safety, and insurance is one of the most readable and popular books published in recent years—**Tornadoes of the United States by Snowden Flora.** Univ. of Oklahoma Press, Norman, 1954 (Second Edition). 194 p. $3.50. There is seldom a book which was as adequate in the first edition (1953) that needs revision within a year after publication; and, even if it does, there is seldom an author who takes the trouble to make a thorough revision when the previous one is hardly off the press. But 1953 was the most memorable year in the history of tornadoes, and Flora immediately set to work to revise every chapter and even the tables of statistics to take care of the new meteorological, insurance, and engineering facts derived from the Worcester, Flint, and Waco disasters.

Another popular, yet technically unimpeach-

able, book is **The Nature of Light and Colour in the Open Air by M. Minnaert,** translated by H. M. Kremer-Priest and revised by K. E. Brian Jay. Dover Publications, New York, 1954. 362 p. $1.95 (paper covers). This delightful book looks at nature from the viewpoint of the scientist—astronomer, optician, and meteorologist—on the one hand, and the artist and lover of nature on the other. The author tells in understandable language "the how and why" of sunlight and shadow, reflection, refraction, brightness, color, contrast, visibility by day, twilight, or at night; and explains rainbows, halos, coronas, luminous plants, animals, and stones, and mirages and "over 100 other phenomena of light and color."

The most readable of the synoptic climatology texts, a type that is so satisfying to the amateur and professional meteorologists who think in terms of the daily weather map instead of in terms of mathematical formulas, statistical frequencies, or generalized climatic classification schemes, is **The Restless Atmosphere by F. K. Hare.** Longman's, Green and Co., New York, 1953. 192 p. $2.40 ($1.80 for textbook edition). Prof. Hare deals with the climates of America, Europe, and the tropics, as illustrated by weather maps for typical situations which prevail under different air mass movements. General principles of meteorology such as radiation, moisture exchange, stability, cyclones, fronts, clouds, and weather are also discussed in a concise manner.

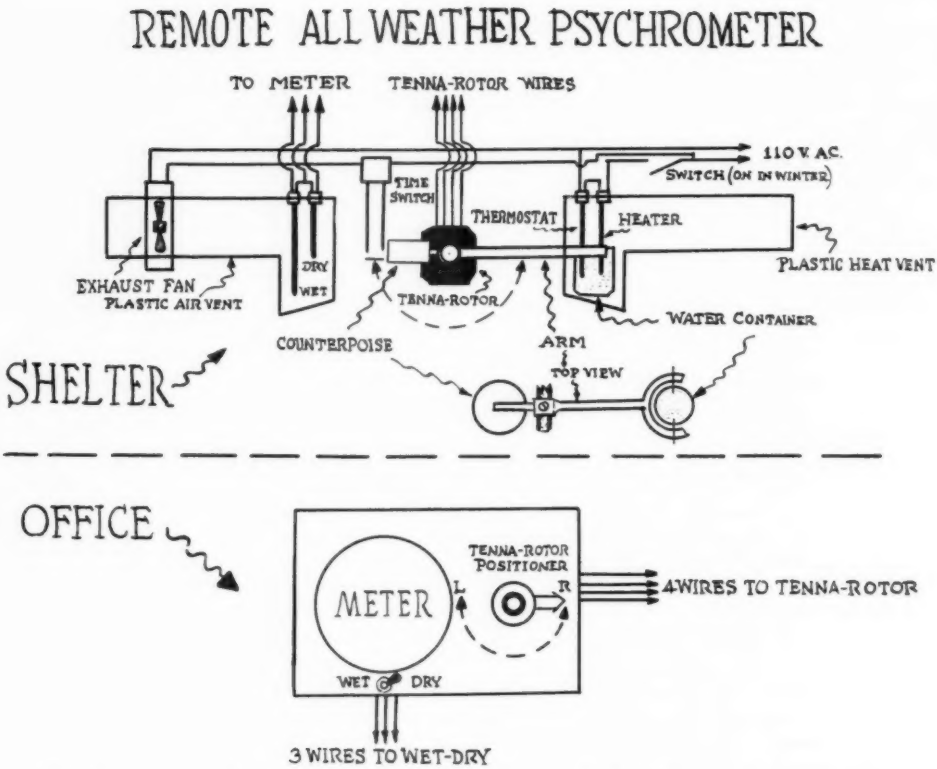
For the student who wishes to study deeper into the systematized field of climatology, I would recommend the third edition of **An Introduction to Climate by Glenn T. Trewartha.** McGraw-Hill Book Co., New York, 1953. 416 p. $7.00. This is a voluminous and attractively printed and illustrated standard textbook which has stood the test of time. The work is intended for teachers colleges and universities, but is not "over the head" of anyone who has had elementary geography and general science. It takes up the elements of weather and climate, climatic classifications, and regional climatology. The third edition contains much new material and seems to have a more critical approach to meteorological problems than do most geography texts.

Those who are interested in the climate characteristics of our country should consult the **Climatic Atlas of the United States by Stephen S. Visher.** Harvard University Press, Cambridge, 1954. 403 p. with over 1,000 maps. $9.00. This amazing volume contains a medley of assorted charts, graphs, and some textual material and tabular data, giving the reader a crude idea of the distribution of rainfall, temperature, sunshine, humidity, evaporation, wind, storms, and climatic zones of the United States. For the area between the Rocky Mountains and the Appalachians the picture is adequate; for the mountainous or coastal areas it is not so meaningful. This atlas, however, should be part of every library, for it appears likely that it will be many years before a large, up-to-date comprehensive atlas of the United States will be published. The present work represents years of effort and compilation by a single individual.

For the reader who wishes to interpret the bountiful treasure of climatic data in terms of living conditions, housing design, or architecture, there are two recent publications which can be appreciated by the layman as well as by the architect and building engineer for whom they were written. **Climate and Architecture, Progressive Architecture Book, by Jeffrey E. Aronin.** Reinhold Company, New York, 1953. 302 p. 291 fig. $12.50. This is a profusely illustrated book with photographs and climatic charts to enable home builders, city planners, student and professional climatologists, and architects to make the best use of sunshine, wind, rain, snow, and temperature data, as well as of topography, vegetation, and shade—to provide more comfortable living in all parts of our country or in any place throughout the world.

Another recent work with emphasis on home building is **Application of Climatic Data to House Design by V. and A. Olgyay and Thomas Malone.** U. S. Housing and Home Finance Agency, Washington, 1954. 152 p. $1.00. Anyone selecting a site for a new home or designing a new structure should study this report. It was written by M.I.T. engineers for an audience of architects, but it is not too technical for those most concerned with comfort, the home owner.

(Continued on page 56)



How the remote psychrometer works: Selector switch is normally in position marked "DRY" and ambient air temperature appears on meter. For wet bulb temperature, turn Tenna-rotor positioner to "L" and rotor arm conveys water container through arc of 180° to immerse wick of wet bulb. Time switch actuated by arm turns on exhaust fan. Return Tenna-rotor positioner to "R" and move selector switch to "WET." Watch meter and read lowest value for wet bulb temperature. Refer to tables or nomograph for relative humidity.

Simplified All-Weather Remote Psychrometer

C. A. WOOLLUM, *Weather Bureau Airport Station, Washington, D. C.*

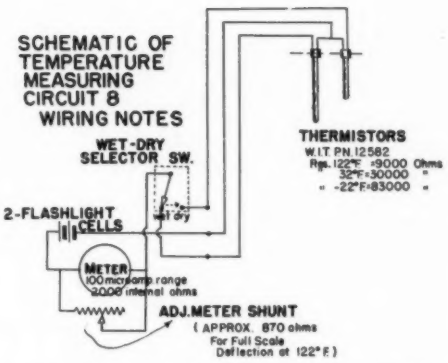
THE simplified remote all-weather psychrometer described in this article, though not endorsed for official psychrometric readings, is presented for information of amateur weathermen as a follow-up to an earlier article. Amateur weathermen who constructed the remote temperature-indicating device in *Weatherwise*, August 1952, will be pleased to know that they may make full use of all components of the present device in constructing the remote all-weather psychrometer. By employing suitable thermistors which are commercially [1] available, any d.c. milliammeter having a sensitivity of 0-1 milliampere

[1] The Washington Institute of Technology has assigned part number 100-434 to a rod-type thermistor intended for temperature measurement in a 1 ma. circuit. Its normal resistance at +30° C is 2,330 ohms. The diameter of the rod permits considerably higher current to flow without deleterious self-heating effects. Consult author for current availability.

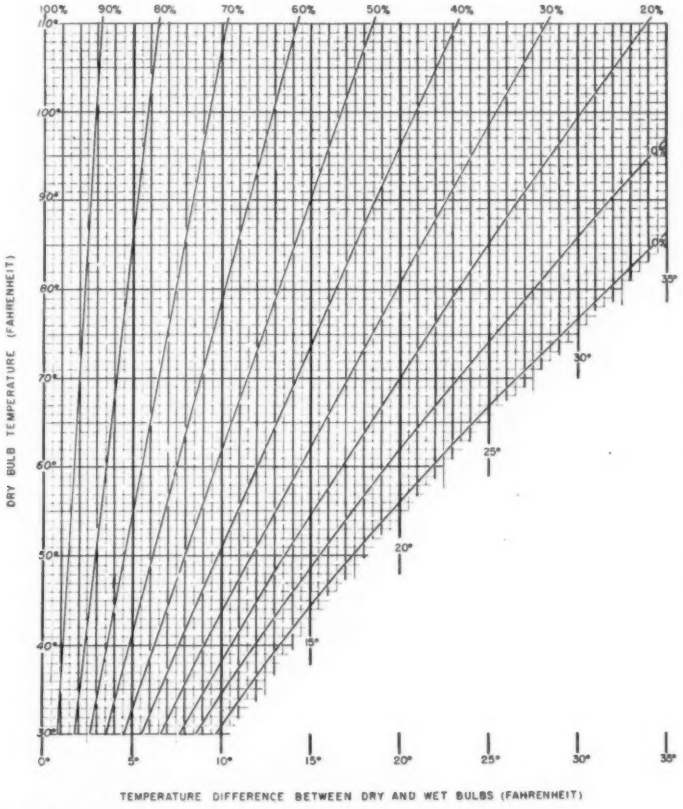
or greater will adapt to the design and dial calibration. For those who wish maximum accuracy of calibration and reading, consideration might be given to a meter having a deflection range of 270°. Such a meter is somewhat expensive, but scale divisions are wide-spaced and permit maximum accuracy of calibration and reading.

Figure 1 illustrates the essential components of the remote all-weather psychrometer. For operation at temperatures above freezing, the thermostat, heating element, switch, and plastic heat vent may be entirely eliminated. These components cost approximately $7 through wholesale radio and electronics parts distributors. The total cost for all components can probably be kept below $50 by those who have established connections for purchase of used and surplus materials. The author has prepared a mimeograph listing of the following component parts with

(*Continued on page 57*)


SCHEMATIC OF TEMPERATURE MEASURING CIRCUIT 8 WIRING NOTES
WET-DRY SELECTOR SW.
THERMISTORS
W.I.T. P.N. 12582
Rys. 122°F =9000 Ohms
32°F=30000 "
" -22°F=83000 "
2-FLASHLIGHT CELLS
wet
dry
METER
100 microamp range
2000 internal ohms
ADJ. METER SHUNT
(APPROX. 870 ohms
For Full Scale
Deflection at 122° F)
3 WIRES TO THERMISTORS: NO.20 OR LARGER AND WELL INSULATED TO AVOID LEAKAGE DUE TO MOISTURE.
4 WIRES TO TENNA-ROTOR CONTROL CABLE AT $2.70/100 FT.
2 WIRES TO EXHAUST FAN & HEATER: NO.14 INSULATED.

Three wires to thermistors: No. 20 or larger and well insulated to avoid leakage due to moisture. Four wires to Tenna-rotor: control cable at $2.70/100 ft. Two wires to exhaust fan & heater: No. 14 insulated.



Psychrometric nomograph. To determine relative humidity: Find point on dry bulb scale corresponding to air temperature. Displace point horizontally corresponding to difference between dry and wet bulbs. Read relative humidity from scale at top of sloping lines.

Weatherwatch

A Varied Winter—1954-55

DAVID M. LUDLUM, *Editor*

ANOTHER winter season has gone into the record books—as is always the case in an area as wide as the United States, there was a great variety of weather conditions experienced. If one lived in the southern half of the country, the season of 1954–55 will be remembered as cool and disagreeable; but if one resided in the northern Plains or upper Lakes region, a very mild and open winter, especially during the first two months, was experienced.

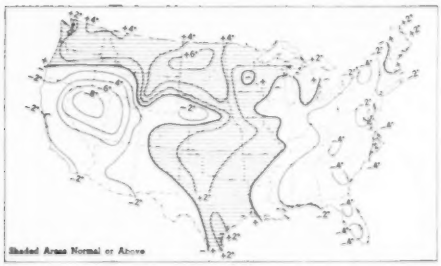
The winter of 1954–55 may be roughly divided into two distinct portions: the division occurred at the close of January when a marked change in the circulation pattern commenced to influence the movement of air masses. In December and January the distribution of temperature zones had been east-west along the lines of latitude, but early in February the zones shifted to a north-south orientation as a low westerly index type of circulation took over.

The outstanding feature of the winter was the relatively mild season experienced across the northern half of the nation, while temperatures for the three-month period averaged below normal in the Southeast and Southwest. The most important economic effects of the temperature and precipitation distribution was felt in the area between the Mississippi and the Rockies. In the northern Plains it was the mildest early winter in many years with zero readings not becoming general until mid-January, the 16th at Minneapolis, the latest on record. In the wheat belt of the southern Plains it was another disheartening droughty period, causing a distinct setback to the hopes raised among dry farmers by the favorable summer and fall rains. Fears of a recurrence of the 1954 dust bowl conditions were again raised.

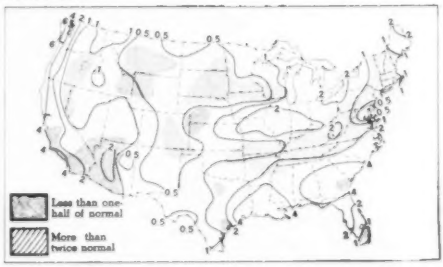
One section of the country was particularly blessed by Old Man Winter, 1955 style. For the first time since the great snow season of 1947–48 snowfall in northern New England came early and remained throughout the entire winter. Higher mountain spots received a good covering at Thanksgiving time, and all of the resorts north of the Massachusetts line benefited by a general snow just before the New Year's Day holidays. And there was no January thaw; cover remained excellent through the first day of Spring which brought more snow to all but the extreme north. The prospects for an excellent corn snow season tor spring skiing remained good.

Resort owners in Florida, however, had little to cheer them until the mercury took a decided turn upward early in February. Even in the southern peninsula temperatures dipped below 40° on several occasions to continue the below-normal series of months in the Southeastern states that commenced in October. A general freeze took place on 14–15 January and three consecutive weeks of inland freezes followed. In the Southwest, too, favorite winter vacation spots had unfavorable conditions. Cold air from the Great Basin frequently penetrated into southern Arizona and kept the nighttime mercury near the freezing mark during much of January. It was windy, too, at the desert resorts to add to the discomfort. Southern California was also in the cool zone though no extreme conditions were experienced. Following a frosty December, freezes were general inland on the 14–15th, the same day that Florida was very chilly. Temperatures, even on the coast, dropped into the 30s many times. Precipitation in the Southwest was generous as Pacific air supplied copious moisture to cheer the hopes of farming interests. The downpour on New Year's

MONTH OF JANUARY 1955



Departure of Mean Temperature from Normal in degrees Fahrenheit. USWB chart.



Total Precipitation in inches. USWB chart.

Day, however, did little to stimulate the spirits of Tournament of Roses enthusiasts at Pasadena.

A study of the mean pressure maps for January and for February shows two contrasting circulation patterns. The main feature of the January map was a remarkably deep cyclonic vortex and trough located in the western Atlantic Ocean to the southeast and east of Newfoundland. This vast depression represented the greatest departure from normal ever noticed in the western Atlantic area since upper-air charts have been available, since 1932. This vortex displaced the position of the usual Icelandic low about 1,000 miles to the southwest. Since the vortex was at a relatively southern location for winter, a blocking high built up over the Greenland-Labrador area to change further the normal flow patterns over the sub-Arctic. This had important repercussions westward across North America and far into the Pacific Ocean. The length of the waves in the westerly flow across the United States was unusually broad. The next anticyclonic ridge to the westward from the vortex spread from British Columbia southward, and the next trough was located in the central Pacific Ocean. This configuration of the pressure contours along which the upper-air flow takes place permitted a long sweep of northwesterly winds across most of the United States. Pacific air entered the Northwest and northern Plains to account for mild conditions there, while a persistent flow of Canadian air kept temperatures normal and below in the Northeast. The northern components in the air flow also explains the persistent cold in Florida and the Gulf Coast.

It was a dry flow of air and many records for deficient precipitation were set in January. Moist Gulf air had little chance to penetrate northward, so it was not a particularly stormy month over the usual battle area of air masses in the Middle West. The Atlantic vortex became the mecca for all traveling depressions—most cyclones, although innocuous while crossing the United States, deepened rapidly as they entered the vortex to make it a very stormy month for trans-Atlantic crossings.

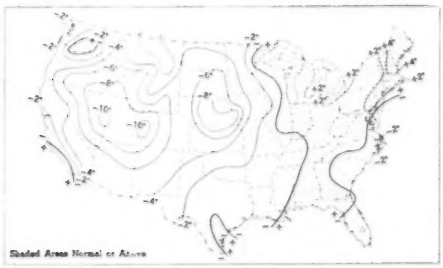
The main storm tracks were either northeastward from the Gulf across the South Atlantic states or southeastward from Alberta in the northwest flow to New England. The southern track accounted for several heavy snowfalls in the Carolinas and Virginia where the month wore a very wintry aspect.

Small snow roller or "snow puffs" at Bar Harbor, Maine, on 16 February 1955. Photo by Bar Harbor Times courtesy of H. Otis Keene.

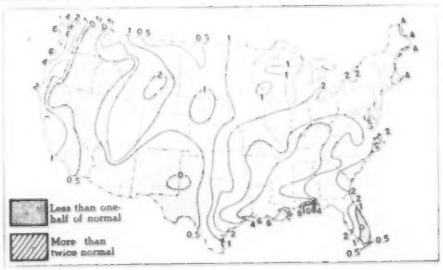
A marked change in the circulation pattern became evident in late January when very cold air commenced to move southeastward out of Canada. A principal feature of the weather map during late January and February was the large reservoir of cold air over the sub-Arctic. The last week of January was severely cold in the Mississippi Valley and the Southeast, and the first days of February were much below normal in the Northeast with the mercury falling to $-40°$ in Maine and to zero in New York City.

The new pressure distribution was signaled by the filling of the North Atlantic trough and its apparent movement westward early in February to a position over the Mississippi Valley; in conjunction with a marked polar vortex that developed over the Canadian Arctic, the central trough controlled the weather over North America. The blocking high over Davis Strait, so important to storm movement in January, was now east of Greenland and a long ridge extended southwestward to cover the Atlantic Coast states. Upstream from the central trough, ridge conditions built up over the Pacific Coast and the eastern Pacific Ocean. A marked low index type of westerly

MONTH OF FEBRUARY 1955



Departure of Mean Temperature from Normal in degrees Fahrenheit. USWB chart.



Total Precipitation in inches. USWB chart.

circulation took form with a western ridge-central trough-eastern ridge pressure configuration.

The central trough opened the way for the cold reservoir over Canada to rush southeastward. A major outbreak occurred on 9–12 February with the zero line penetrating south of the Ohio River and into Arkansas. A drop of 57 degrees in 18 hours was registered at Parkersburg, West Virginia. Another polar outbreak on the 18–19th caused the first blizzard conditions of the winter over the northern Plains, and the cold continued through the last week of February, which averaged out the coldest of the winter so far in the Upper Lakes and northern Plains with the mercury dropping as low as −40° in Minnesota.

Further east the severe cold of the early days of February moderated as ridge conditions brought a southwesterly flow, and by the end of the month the temperature deficiencies of the first two weeks were cancelled out by marked late-month warmth. In the Southeast maxima soared daily into the 80s in a record early-season heat spell.

The warm moist air brought plenty of snow to northern New England. Storm totals of 36" were reported in the press on the 17–18th, and total depths of 80" in the Mt. Katahdin sector. At sea level in the Bar Harbor area a fall of 24" had a water content of 3.10", and the storm was "probably the most damaging in many years," as a coating of wet snow up to five inches in diameter encrusted and downed communication lines.

February, however, merely set the stage for the continuance of winter into March which proved to be one of the stormiest and meteorologically costly equinoctial months on record.

Books *(Continued from page 51)*

Any reader who may be so fortunate as to take a trip abroad with a visit to the British Isles should secure one of two recent popular books: **Climate and the British Scene by Gordon Manley.** Collins, London, 1953. 314 p. 25s. This summation of a lifetime's personal and professional encounters with the British climate discusses all aspects of climate and weather, especially as it affects man, climatic changes, and the peculiarities of British weather. The material is made more vivid by an excellent selection of color photos of landscapes under varying seasonal weather conditions. Prof. Manley, like Prof. Hare, is primarily a geographer by trade, but writes as a meteorologist, as he too thinks of climate in terms of daily weather maps with moving air masses, cyclones, and fronts rather than in the dead terms of averages or arbitrary climatic zones based on vegetation types.

An even easier reading, but equally competent book for vacationers in the British Isles is **The English Climate by C. E. P. Brooks.** English Universities Press, London, 1954. 214 p. 12s 6d. This gives many interesting facts about wind, sun, and rain interpreted in terms of human comfort and activity: how and where to build a house and where and when to take a vacation. There are applications by analogy to many other parts of the temperate zone having similar climates such as our Pacific Northwest.

Anyone who has been fascinated by the classic work on snow crystals by W. A. Bentley (1931) will be equally impressed by **Snow Crystals; Natural and Artificial by Ukichiro Nakaya.** Harvard University Press, Cambridge, 1954. 510 p. 188 plates. 514 figs. $10.00. This recent work represents the culmination of 20 years of faithful research into the physics as well as the structure and photography of natural and artificial snow and frost crystals as produced in cold chambers, on window panes, and on outdoor objects. The hundreds of beautiful photomicrographs are classified according to type of formation as well as to structure.

The modern science and practice of rain making, which is a by-product of research on ice and snow crystal formation by amateur observers such as Bentley, Nakaya, and Schaefer, working on mountain tops and with simple cold chambers, has been fully exploited by professionals so that it has become a million dollar business for the last few years. The world-wide activities of one of the most famous of the scientific rain makers is graphically described for the layman in **Sun, Sea and Sky by Irving Krick and Roscoe Fleming.** Lippincott, Philadelphia, 1954. 248 p. $3.95. In addition the most recent developments in meteorology are discussed: the jet stream, weather and war, climatic changes, synoptic and analog forecasting, and both short and extended range forecasting. The illustrations are clever and the book easily read and informative, especially for anyone interested in the practical aspects of meteorology and in the use of weather information in solving his daily business and living problems.

A more orthodox, yet equally up-to-date, treatment of the principles of meteorology for the student who wishes to go on with advanced courses in meteorology, climatology, or aeronautics is **Elementary Meteorology by G. F. Taylor.** Prentice-Hall, New York, 1954. 364 p. $7.95. All of the recent developments in meteorology and climatology

which resulted from the intensive wartime applications and training of professional meteorologists are worked into this book, which is intended for senior high school and junior college students.

A less involved treatment for upper elementary school age students that is both technically sound and very timely is **All About the Weather by Ivan R. Tannehill.** Random House, New York, 1953. 148 p. $1.95. This attractively illustrated volume deals with observations, forecasting storms and hurricanes, radar storm detection, aircraft reconnaissance, the services of cooperative observers, and the various functions and services of the U. S. Weather Bureau.

The recent visitation of hurricanes into northern climes has emphasized the influence that the tropical regions play in world-wide weather. A systematic treatment, **Tropical Meteorology by Herbert Riehl.** McGraw-Hill Book Co., New York, 1954. 392 p. $8.50, takes up the weather, climate, synoptic and dynamic meteorology of the tropics and subtropical regions. It is a substantial and well-illustrated text, and is especially valuable for the discussion of convective clouds, trade winds, typhoons and hurricanes, waves in the easterlies, and rain from non-freezing clouds. It is essentially non-mathematical and so can be enjoyed by everyone.

In subsequent issues of Weatherwise the writer will discuss other recent popular and technical works that deal with meteorological subjects. There has been a marked increase in publication activity in this field, and it is hoped that these summaries will be of service to those who wish to be appraised of the general content of new publications.

PILOTS' WEATHER HANDBOOK

A completely revised successor to Benarthur Haynes all-time best seller in meteorology, *Meteorology for Pilots* (1943), has just been issued. The present work was prepared by the staff of the U. S. Weather Bureau and published as CAA Technical Manual No. 104. *Pilots' Weather Handbook* contains 144 well-illustrated pages. It may be obtained from the Supt. of Documents, Government Printing Office, Wash. 25, D. C. for $1.25.

Psychrometer (*Continued from page 53*)

costs and names of suppliers which will be forwarded to those addressing a request to him directly:

1. Tenna-rotor
2. Meter
3. Wet-dry selector switch and AC switch
4. Exhaust Fan
5. Two Thermistors
6. Time Switch
7. Thermostat
8. Heater
9. Plastic venting
10. Arm-bucket and gimbal

The arm and bucket assembly, No. 10, will have to be fabricated locally. It would appear advisable to counterbalance mass of arm and bucket so that tenna-rotor would not be subject to pull of gravity exerted on mass of arm and container of water. Bucket is supported in gimbal to maintain upright position at all times.

Details of dimension have been deliberately omitted since some may desire to make up the two parts of the device as compactly as possible to permit portability. The tenna-rotor selected by the author requires four wires and rotates through the required 180 degrees of arc in thirty seconds. The thermistors, both wet and dry, are sealed in thin wall glass tubing with a bore just large enough to permit insertions of thermistor. Both wires of thermistor are brought out through one end of the glass tubing and the other end is sealed by melting the glass. To avoid damaging thermistors by excessive heating, the glass rods are prepared before thermistors are inserted. Wicking similar to that for mercury in glass thermometers is placed over the glass tubing containing the wet thermistor which is positioned so that it will be immersed in water when the tenna-rotor positioner is turned to the wetting position. In below freezing conditions the tenna-rotor should be left in the wetting position for about one minute to melt off ice accretion on the bulb and wick of the wet bulb.

Figure 2 illustrates schematically the temperature measuring circuit and contains notes regarding wiring suggestions. Additional flashlight cells are required for a meter having a range of 0–1 milliampere. The value of the shunt resistance will vary with meter resistance and range.

An easily prepared nomograph, with psychrometric values of dry bulb temperature and wet bulb depression as co-ordinates and

sloping lines as equivalent values of relative humidity, speeds up computation of psychrometric data. Such a nomograph can be prepared from Weather Bureau Psychrometric Tables available from the Government Printing Office at a cost of $.05.

Atmospheric Physics

(*Continued from page 49*)

evaporation of the dry ice to circulate the cold solution through cooling coils in contact with the outside of the cold chamber. An easier method is to use pieces of dry ice to produce cold air in the space surrounding the inner cold chamber. If this method is used, it is very important that the dry ice does not touch the surface of the inner chamber. If this occurs, there is a danger that a local cold zone will develop that is colder than −40° C in view of the fact that dry ice has a temperature of −78.5° C. Spontaneous ice crystal formation occurs at about −40° C so that some peculiar effects will occur which may be hard to understand. If dry ice alone is used, the outer chamber may be made of several layers of corrugated cardboard, which serves as both holder and insulator, as illustrated in the accompanying figure.

Illumination of the chamber should be accomplished with a light source such as a three cell flashlight, a 35 mm film projector, a microscope stage illuminator, or any other light source that will give a parallel beam of light from two to four inches in diameter. If the light is too bright, it may warm the walls of the chamber. A trick that will overcome some of this trouble is to locate a mirror in the corner of the chamber, adjusting it so that it reflects the light back in the same direction from which it came. This not only reduces local heating in the chamber, but also increases the brightness of the light beam.

It is best to direct the beam into the chamber at an angle of about 45 degrees. This illuminates a good cross section of the cold air and also most effectively shows up the ice crystals which we will produce in some of our experiments.

When a chamber is prepared by one of the methods suggested and reaches a temperature of about −20° C. it can be tested by slowly exhaling four or five lungfuls of air into the illuminated chamber. A whitish gray fog should appear and remain as a floating cloud with its particles visible as tiny droplets. This is a supercooled cloud.

Take a piece of dry ice, holding it with a glove or several layers of cloth, and scratch it with a nail or other sharp, pointed instrument, while holding it over the cloud-filled chamber. The spectacular change which occurs in the cloud will be explained in our next article in the June issue of *Weatherwise*, together with other methods of producing changes to the cloud in the cold chamber.

Formosa

(*Continued from page 43*)

temperatures above 3,500 feet. Aircraft icing problems can be avoided by flying below 3,500 feet or above the cloud tops which generally do not extend above 12,000 or 13,000 feet. Sea ice and freezing spray do not occur in the immediate vicinity of Formosa or the Strait.

4) Cloudiness, precipitation, and the resultant restriction to visibility will hamper air-to-ground operations. Radar reception will be restricted, particularly during the summer months, owing to the high moisture content of the cumulus clouds. Autumn is a favorable time of year for the entire island for flight operations. Considering cloudiness and visibilities for the entire west coastal area, visual air-to-ground operations can best be conducted from July through October, with noon being the best time of day. Typhoons will, of course, disrupt operations for relatively short periods of time.

5) The high frequency of heavy rain in late spring and summer (winter in northeastern Formosa) will hamper outdoor maintenance of equipment.

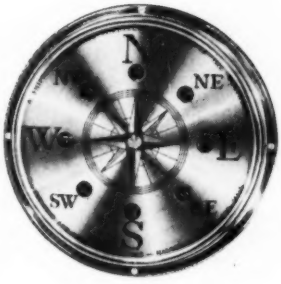
6) Temporary and permanent installations should be carefully located to minimize the danger from floods and the hazards of wet soil conditions, which generally exist from spring to early autumn for most of the island and during the winter months for the northeastern area.

7) During the summer months the combination of high temperatures, high humidities, and low wind speeds will seriously reduce the efficiency of personnel accustomed to more temperate climates.

WIND INSTRUMENTS

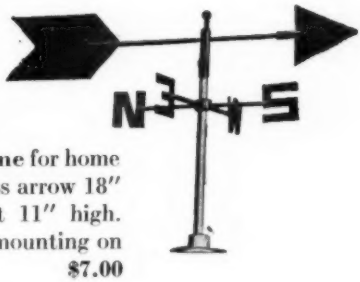
No. 410. Wind Speed Indicator. Three-cup anemometer is mounted out-of-doors and registers speed of wind directly in miles per hour on an indoor indicator. The 4-inch polished brass dial registers up to 100 mph. Spinning cups generate a small current which is measured on the volt-meter indicator. No external power source is required. Anemometer is connected by low voltage 2-conductor No. 22 wire. Diameter of cup rotor is 10″. Height of pipe support is 12″. Complete, ready for installation and operation, with 50 feet of wire. Wt. 4 lbs. **$49.95**

No. 411. Wind Direction Indicator. A small wind vane is mounted out-of-doors and transmits wind direction to eight compass points on an indoor indicator. The vane has eight built-in contacts which complete an electrical circuit to the indicator. The vane assembly is connected by 9-conductor cable to the eight lamps of the indicator. The proper lamp flashes for the current wind direction. Dial measures 7½″ in diameter and ¾″ deep. Operates on 110 v. A.C. current. Outdoor support 12″ high. Complete with 50 ft. of cable. Wt. 4 lbs. **$49.95**



No. 431. Design Wind Vanes. These attractive wind vanes are both practical weather instruments and ornamental assets for your house or garage. Many designs available; send for complete folder. Two sizes:

22″ arrow **$14.95**
30″ arrow **$19.95**



No. 430. Simple Wind Vane for home home or garage. Black brass arrow 18″ long swings freely on mast 11″ high. Flange and screws for easy mounting on flat surface. **$7.00**

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